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B. I. SCHMIDT

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COMPOSITION FOR MAKING MOLDS

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FIG. 1.

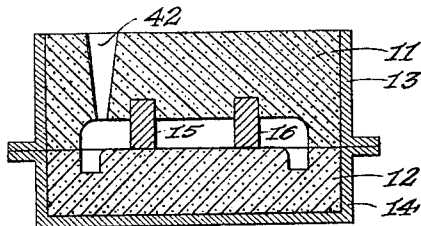


FIG. 2.

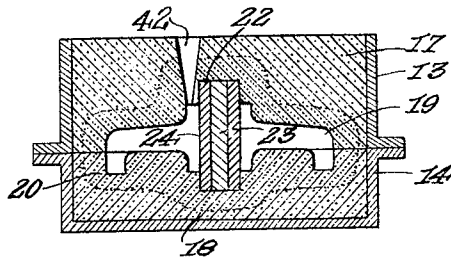


FIG. 3.

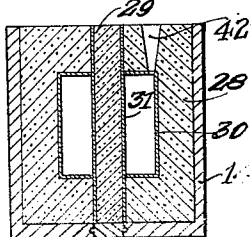
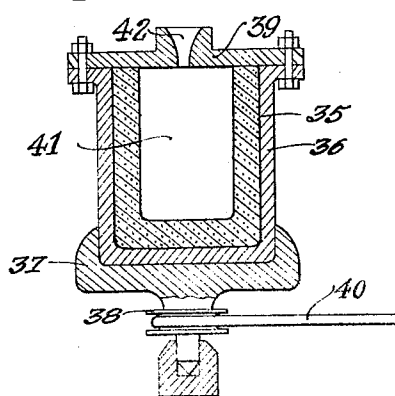


FIG. 4.



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## UNITED STATES PATENT OFFICE

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## COMPOSITION FOR MAKING MOLDS

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5 Claims. (Cl. 18—47)

The invention relates to molds for casting metals, plastics or the like materials, and more particularly relates to a composition for making such molds and to the molds so produced. The expression "mold" as used in the specification and claims is intended to include the base mold, or matrix into which the metal is cast, and the core, template or shaper used therewith and similar form-giving structures.

More specifically the invention is concerned with a new binder for pulverulent materials such as molding sand, plaster of Paris and the like which are used in casting metals and other moldable materials.

In certain casting processes for molding metals the molds are not permanent but are destroyed after each casting operation and hence they are termed "waste molds." Such waste molds are usually made of sand, loam or plaster of Paris but they must be sufficiently rigid and refractory to withstand the pressure and temperature of the casting process but, after completion of this process, they should be brittle enough to be easily broken apart without damage to the cast object and the granular material should be capable of reuse. These contradictory conditions complicate the task of finding appropriate binders especially in cases where difficult requirements are to be met with such as, for instance, in centrifugal casting where the molten metal under centrifugal force exerts high pressure upon the inner surface of the mold.

It is therefore a primary object of this invention to provide a new binder for the granular materials used in making "waste" molds which when admixed with such materials and solidified, imparts a surprisingly firm bond together with high tensile strength to the mold but which structure is easily broken and granulated thereafter so that the pulverulent material may be reused.

It is a further object of the invention to provide molds which retain their shape even under severe casting conditions as are found in the centrifugal casting of molten metal.

Another object of the invention is to avoid the formation of noticeable fire scale on the surfaces of the casts and to provide a carbonizable facing material for molds.

A still further object of the invention is to provide molds for casting articles with fine details and without the risk of thin edges being chipped off from the mold or the cast object.

According to the present invention there is provided, in the process of making molds, in

particular "waste molds" for casting metals and plastic materials, the steps of mixing a pulverulent mold-forming material with an aqueous dispersion of a coagulable cellulosic material as a binding agent and coagulating the cellulosic material to bind the pulverulent material. The plastic material to be molded is cast into the mold, with or without drying the mold, and after the plastic has set or hardened, the mold is broken open, the cast object removed and the mold material may be granulated and reused.

The invention is applicable for making molds from dry sand, loam (a mixture of clay and sand), plaster of Paris, and the like, and the molds may be open, closed or "loam worked" molds, and may be used in still casting or centrifugal casting and the molds may be temporary, i. e., "waste," or permanent.

For building up these molds, I may use any pulverulent material which is sufficiently refractory and inert under casting conditions. The expression "pulverulent material" in the specification and claims is thus intended to include molding sand, plaster of Paris, hydraulic cement, and other mold-forming materials such as are conventional or useful in the art of casting metals, plastics, wax or other moldable materials.

The coagulable cellulosic materials which may be employed as the binding agent comprise as a class, those hydrophilic cellulose ethers which are soluble in water and aqueous alkali solutions or which are alkali-soluble but water-insoluble, such for example, as alkyl cellulose ethers, hydroxy-alkyl cellulose ethers, carboxy-alkyl cellulose ethers, and the like, such for example, as methyl cellulose ethers, hydroxy-ethyl cellulose ethers, as well as mixed alkyl-hydroxy-alkyl cellulose ethers such as ethyl-hydroxy-ethyl cellulose, and the like. The carboxy-alkyl cellulose ethers may comprise for example, cellulose glycolic acid ether and sodium and potassium salts.

In addition there may be employed other alkali-soluble water-insoluble cellulosic materials such as cellulose xanthate, cuprammonium cellulose, and cellulose, including waste regenerated cellulose, which has been rendered alkali-soluble by degradation by heat, acids, alkali and the like, which treatment results in a product which is soluble in an alkaline solution of sodium zincate or sodium stannate or which is soluble in alkali, such as 8%-10% caustic soda, especially by first freezing and then thawing the solution. Further there may be used dispersions of cellu-

lose (including waste regenerated cellulose) in suitable cellulose solvents such as hot acidified zinc chloride, alkali perchlorates, alkali metal thiocyanates, concentrated sulfuric acid and phosphoric acid.

Alkalis in which cellulosic material is dispersed may include sodium hydroxide, potassium hydroxide, quaternary ammonium hydroxide, or organic bases, such as tetra benzyl ammonium hydroxide, tri-benzyl methyl ammonium hydroxide. From their aqueous alkaline dispersions the cellulose ethers or cellulosic materials may be precipitated by the same coagulants which are used for precipitating the alkali-soluble cellulose ethers. From dispersions in salt solutions the cellulose may be precipitated by appropriate agents well known to the art. The term "dispersion" as used in the specification and claims, includes true solutions, colloidal systems and suspensions.

The amount of the cellulosic material used in the dispersion may be varied widely depending on the viscosity required. Fillers such as wood flour, clay, starch, and the like and pigments may be added to thicken or color the dispersion. By way of illustrating the invention, but not by way of limiting its scope, the dispersion may comprise in each 100 parts from 2 to 8 parts by weight of the cellulosic material, and 3 to 10 parts alkali, and the remainder water. In the event that the alkali is both liquid and a cellulose solvent, such as the quaternary ammonium bases, the water may be omitted and the alkali will then be the sole solvent.

This dispersion may be admixed with pulverulent material to form a magma from which part or all of the mold may be built up. The mold may be used wet or it may be dried, by means of heat, whereupon the cellulosic material coagulates and the magma solidifies to form a hard firm mold. Or a part only of the pulverulent material may be admixed with the cellulosic binder to build up a part of the mold or for the making of a facing on the interior of the mold, the remainder of the mold being formed from pulverulent material not containing the cellulosic binder or being bound together by some other binder, such as the conventional oils, molasses, dextrine or flour pastes, thin clay wash and the like.

The magma of the invention consisting of an admixture of the pulverulent material wet with the dispersion of the alkali-soluble cellulosic material may also be used for making the cores or mandrels or for surfacing a core or mandrel made of metal, plaster, glass, wood, fire-brick and the like.

The binder material may also be used for facing and, for this purpose, may be applied to the inner surfaces of the mold or the outer surface of the core or mandrel by washing, spraying, brushing, and dipping. It may also be used in a more concentrated form and applied to such surfaces by means of a spatula.

By appropriately heating the mold by means of a torch flame for instance, or in a heating chamber or oven, or otherwise, the excess of water will be expelled, the cellulose compound will coagulate to bind together the pulverulent material and solidify the mold. The mold may also be heated prior to the casting process or during this process to a temperature at which the cellulose will coagulate and then graphitize. In this way the composition of the invention may

be used as a facing material instead of, or in addition to, the conventional facing composition containing powdered charcoal, graphite, Ceylon lead, East India plumbago, soapstone, talc or others.

For a more complete understanding of the nature and objects of my invention reference should be made to the drawing annexed to this specification and forming part thereof and in which:

Fig. 1 is a side elevation in section of a mold with cores for casting a disc having two openings therein;

Fig. 2 is a side elevation in section of a mold with core for casting a wheel;

Fig. 3 is a side elevation in section of a mold with core for casting a hollow cylinder; and

Fig. 4 is a side elevation partly in section of a rotatable mold for centrifugal casting.

In the embodiment illustrated in Fig. 1, 11 and 12 are the two halves of the molds held by two casings, 13 and 14, forming a mold box. The mold and the cores 15 and 16 are prepared from an admixture of sand or other pulverulent material using as a binder a dispersion of alkali-soluble cellulosic material as indicated by the double cross-hatchings.

In the embodiment shown in Fig. 2, those parts, 19 and 20, of the mold halves 17 and 18, respectively, which form the layers of granular material adjacent the mold cavity only, are, as the double cross-hatching indicates, prepared from said admixture of sand or other pulverulent material and with the alkali-soluble cellulosic binder, the other parts of the mold halves being made, in any conventional manner, of sand with or without a binder.

The core 22 consists of an inner skeleton, rod 23, coated with a layer 24 made of the mixture of sand and alkali-soluble cellulosic binder.

In the embodiment of Fig. 3, the mold 28 and core 29 are prepared in any conventional manner. Their surfaces, 30 and 31, respectively, which form the mold cavity are provided, however, with facings made from the composition of this invention.

Fig. 4 shows one embodiment of a mold for centrifugal casting, in which the mold 35, held within a shell 36, having a removable lid 39, is made of the mixture of pulverulent material bound with the alkali-soluble cellulosic material and solidified by heating as herein described. It is placed on a rotary table 37 which may be rotated with great velocity by means of the belt 40 driving the pulley 38 or by any other conventional driving means, while the molten metal or other material is poured into the cavity 41 through the opening 42.

It will be noted in the drawing that the molding box shown in Figs. 1 and 2 is divided horizontally, but it is to be understood that the two halves of the mold are separately formed in molding boxes and then brought together as shown in Figs. 1 and 2. In contrast thereto, the mold and the molding box shown in Fig. 3 are both divided vertically, the parts of the molding box being held together by suitable "steady" pins or clamps in a conventional manner. The molding boxes may be made of wood or iron or any other suitable material which will stand the drying process required to harden the mold.

By way of illustration but not by way of limiting the invention, there will be given the following specific examples:

*Example 1*

A solution is prepared comprising 6 parts alkali-soluble water-insoluble hydroxy alkyl cellulose ether, 6 parts sodium hydroxide, and 88 parts of water. The cellulose ether is caused to go in solution by first wetting it with some of the alkali solution, then mixing the cellulose ether with the remainder of the solution, and finally freezing and then thawing the solution, whereupon the cellulose ether will be uniformly dispersed. The cellulose ether solution thus prepared is mixed with gypsum plaster, using the cellulose ether solution in place of part or all of the water normally used to hydrate such plaster. The magma thus produced is charged into a molding box and tamped around the pattern or core until the mass is firm. After the gypsum plaster has set, the pattern or core may be removed and the mold may then be used for casting without any forced drying of the mold. The cast objects will be clean of surface and free from sticking plaster.

*Example 2*

The cellulose ether solution is prepared as in Example 1 and the solution is mixed with sand and charged into a molding box about a suitable pattern or core. The core itself may be molded from a mixture of a cellulose ether solution and wood flour. The mold and the core are then subjected to heat until the cellulose ether is coagulated and the sand dried. In the dried product the cellulose ether holds the sand particles firmly in the desired shape. The mold faces, that is, the interior of the mold, are sprayed with the cellulose ether solution and then flame-dried. Such a mold may be employed for casting steel and the product so cast will have an exceptionally smooth finish, close tolerance and fine details.

*Example 3*

The process of Example 2 is repeated by using, instead of the cellulose ether solution given therein, a solution prepared by mixing 6 parts of a water-soluble methyl cellulose with 94 parts of water.

*Example 4*

The process of Example 2 is repeated but the cellulose ether solution is substituted by a solution formed by dissolving comminuted waste Celophane in a solution comprising 8 parts of sodium hydroxide, 2 parts of zinc oxide, and 90 parts of water, and the mixture is then cooled to 0° C. and then warmed with stirring. The solution of degraded cellulose thus prepared is used as the binder for sand and the process carried out as in Example 2.

Owing to the high cohesive power of the alkali-soluble cellulosic material and its elasticity, the molding process, even of patterns with fragile details, is greatly facilitated and simplified.

The high binding power of the alkali-soluble cellulosic substances as used in the present invention will produce an extremely firm bond of the structure, and a hard, firm mold of high tensile strength will result. This structure is highly qualified for withstanding the high temperature and the high pressure of the casting process even under extreme conditions, without any softening or breaking of the structure.

Moreover, the caustic constituent of the binder will, at the casting temperature, to some extent combine with the siliceous material at the mold or core surface and thus form a flux or cause a slight sintering of the mold or core surface. This enhances the formation of a smooth surface of the cast and prevents the formation of a deep fire scale.

The casts produced by the molding process and composition of the invention are therefore highly useful in precision casting, as they reproduce precisely without loss of detail the form-giving surface of the mold or core. They require a minimum of hand shaping and tamping. The process and the composition of this invention may therefore be applied in mass production work where machining is to be avoided or substantially reduced in its extent.

However, because the cellulosic binders used in the present invention are not substantially film-forming, the mold, after casting, can readily be broken and then granulated so that the pulverulent material can be reused.

I claim:

1. A composition for making molds for casting comprising a mixture of molding sand with an alkaline dispersion of an alkali-soluble, water-insoluble cellulose ether.
2. A composition for making molds for castings, comprising a pulverulent ceramic material and a binder therefor comprising an aqueous dispersion of a hydrophilic cellulose ether.
3. As an article of manufacture, a mold for casting moldable materials formed of pulverulent ceramic material bound together by a coagulated hydrophilic cellulose ether.
4. A composition for making molds for castings, comprising a pulverulent ceramic material and a binder therefor comprising an aqueous dispersion of a hydrophilic cellulosic material capable of being coagulated by heat selected from the group consisting of cellulose ethers, cellulose xanthate, cuprammonium cellulose, and alkali-soluble degraded regenerated cellulose.
5. As an article of manufacture, a mold for casting moldable materials formed of pulverulent ceramic material bound together by a coagulated hydrophilic cellulosic material selected from the group consisting of cellulose ethers, cellulose xanthate, cuprammonium cellulose, and alkali-soluble degraded regenerated cellulose.

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